PhytoKeys 194: 1–13 (2022)
doi: 10.3897/phytokeys.194.80129
https://phytokeys.pensoft.net

RESEARCH ARTICLE

A peer-reviewed open-access journal
PhytoKeys
Launched to accelerate biodiversity research

Tectaria danangensis (Tectariaceae), a new fern species from Vietnam

Van The Pham[1,2], Shu-Han Li[3,4], Shi-Yong Dong[3,5]

1 *Laboratory of Ecology and Environmental Management, Science and Technology Advanced Institute, Van Lang University, Ho Chi Minh City, Vietnam* **2** *Faculty of Technology, Van Lang University, Ho Chi Minh City , Vietnam* **3** *Key Laboratory of Plant Resources Conservation and Sustainable Utilization, South China Botanical Garden, Chinese Academy of Sciences, Guangzhou 510650, China* **4** *University of Chinese Academy of Sciences, Beijing 100049, China* **5** *Center of Conservation Biology, Core Botanical Gardens, Chinese Academy of Sciences, Guangzhou 510650, China*

Corresponding author: Shi-Yong Dong (dongshiyong@scib.ac.cn)

Academic editor: Blanca León | Received 6 January 2022 | Accepted 17 February 2022 | Published 11 April 2022

Citation: Pham VT, Li S-H, Dong S-Y (2022) *Tectaria danangensis* (Tectariaceae), a new fern species from Vietnam. PhytoKeys 194: 1–13. https://doi.org/10.3897/phytokeys.194.80129

Abstract

A new fern species, *Tectaria danangensis* (Tectariaceae) from Vietnam, which had long been misreported as *T. crenata*, is described and illustrated. The new species resembles *T. poilanei*, a species long neglected in the fern flora of Indochina, in the frond shape and sori arrangement, but differs by its irregularly 2-rowed sori (versus regularly 2-rowed, distantly and evenly arranged) between lateral veins of pinnae, fronds being more or less dimorphic (versus monomorphic) and basal pinnae each with a base-joined (versus free) lobe. Phylogenetic analyses of five plastid regions (*atpB*, *ndhF* + *ndhF-trnN*, *rbcL*, *rps16-matK* + *matK* and *trnL-F*) suggested *T. danangensis* has a close affinity to *T. harlandii*. *Tectaria danangensis* appears to be an intermediate species between *T. harlandii* and *T. poilanei*.

Keywords

Indochina, morphology, molecular phylogeny, taxonomy, *Tectaria crenata*

Introduction

The fern species *Tectaria crenata* Cav. represents a morphologically distinctive group in the genus *Tectaria* Cav. (Tectariaceae). It was originally described on the basis of plants from the Mariana Islands and is characterised by the 1-pinnate fronds and indusiate sori in regular rows parallel to lateral veins of pinnae (Copeland 1907). Tardieu-Blot

Copyright *Van The Pham et al.* This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

and Christensen (1941) recorded *T. crenata* in the flora of Indochina and cited five collections from Vietnam. However, *T. crenata* was reported by Holttum (1991) only from western Malesia, Philippines and southern Pacific Islands, but not in Indochina (including Cambodia, Laos, southern Myanmar, Thailand and Vietnam). The distribution of *T. crenata* in Vietnam remains uncertain (Hassler 2004–2021).

During recent years, we examined herbarium specimens of *Tectaria* from Asia in many herbaria and did not find any specimens of *T. crenata* from Indochina (excluding Peninsular Thailand) with typical morphology of this species as those in Malesia and Pacific Islands. The specimens from Vietnam, cited as *T. crenata* by Tardieu-Blot and Christensen (1941), turned out to represent an undescribed species which is reported here as *T. danangensis*. To test the relationships of *T. danangensis* with other species, we also conducted phylogenetic analyses of sequences of five plastid regions (*atpB*, *ndhF* + *ndhF-trnN*, *rbcL*, *rps16-matK* + *matK* and *trnL-F*).

Methods

For morphological comparisons, we studied herbarium specimens from Indochina in Herbaria BM, BO, CDBI, E, HN, HNU, IBSC, K, KUN, L, P, PE, SING and TAIF. We also conducted field observations of *Tectaria* species in Vietnam focusing on the variations of frond dimorphism, the shape and number of lateral pinnae, venation, sori arrangement and the presence or absence of indusia.

To infer the phylogenetic position of *T. danangensis*, we assembled a sequence matrix containing five plastid regions (*atpB*, *ndhF* + *ndhF-trnN*, *rbcL*, *rps16-matK* + *matK* and *trnL-F*) of 61 specimens (Appendix 1). The sampling was based on previous phylogenetic studies of *Tectaria* by Ding et al. (2014), Zhang et al. (2017) and Dong et al. (2018). *Tectaria crenata* was revealed to be a non-monophyletic species, but its sampled specimens from western Malesia to the Solomon Islands were resolved in a strongly supported clade with *T. decurrens* (C. Presl) Copel. and *T. sulitii* Copel. (Dong et al., in press). One of the analysed specimens, *Chen et al. SITW11094* (BSIP, IBSC, TNM), was used here to represent *T. crenata*. Except for one specimen of *T. danangensis* (i.e. *Dong 4909*) which was newly sequenced and analysed in this study, other specimens were analysed in previous studies and their corresponding sequences are available in GenBank. The methods to obtain and align the five cpDNA sequences for *Dong 4909* have been as described in Ding et al. (2014).

We analysed the matrix using Bayesian Inference (BI), Maximum Likelihood (ML) and Maximum Parsimony (MP). The MP analysis was conducted in PAUP* version 4.0d100 (Swofford 2002), with all characters weighted equally and gaps treated as missing data. One thousand heuristic replicated searches were carried out using random stepwise addition with branch swapping by tree bisection-reconnection (TBR), saving 100 trees per replicate. Bootstrap values (BS) were calculated with 1000 heuristic bootstrap replicates, one random sequence addition and TBR swapping. For BI and ML analyses, we used the software jModelTest (Posada 2008) to determine the best-

fitting substitution models for the concatenated sequences and the results suggested GTR+G+I as the best-fitting model. The BI analysis was conducted with MrBayes 3.2.6 (Ronquist et al. 2012), using 10 million generations with one tree sampled every 1,000 generations; four runs with four chains were performed in parallel. The first 25% trees were discarded as burn-in. The ML analysis was conducted using raxmlGUI 2.0 (Edler et al. 2020). A thorough tree search for the best ML tree was performed. The ML bootstrap analysis was performed with 1000 replications. The analysed sequence matrix and resulting trees are available in Dryad Digital Repository (https://doi.org/10.5061/dryad.51c59zw9t).

Results

Morphological comparisons showed that the specimens recorded as *T. crenata* by Tardieu-Blot and Christensen (1941) represent an undescribed species which is recognised as *T. danangensis*. This new species superficially resembles *T. crenata* in the 1-pinnate fronds and entire pinnae, but distinctly differs in sori features, such as being borne on anastomosing veins (versus terminal on free veins included in areoles) and in irregular two rows (versus regularly 2-rowed, distantly and evenly arranged) between lateral veins of pinnae/segments (Fig. 1A and B). Based on herbarium specimens and recent collections, we found that *T. danangensis* is quite variable in the frond dimorphism, with fertile fronds contracted to different extents compared with sterile ones and its sori are in irregular two rows between lateral veins, close or distant to each other. A few specimens of *T. danangensis* with less contracted fertile fronds are similar to those of *T. poilanei* Tardieu, but differ mainly in their irregular 2-rowed sori (versus regularly 2-rowed) between lateral veins, upper pinnae mostly being adnate (versus pointed) to rachis and basal pinnae each having a basiscopic base-joined (versus free) lobe (Figs 1 and 2). We detected a total of 25 herbarium collections of *T. danangensis* containing fertile fronds, of which seven collections bore evidently abortive sporangia.

Our phylogenetic analyses of cpDNA sequences with all three methods (BI, ML or MP) consistently resolved *T. danangensis* in Clade IV-8 of *Tectaria* (Fig. 3). Based on the current sampling, two specimens of *T. danangensis* and an unidentified specimen (*Zhang et al. 8817*, for which we had no chance to examine the morphology) formed a strongly support sister relationship with *T. harlandii* clade including *T.* × *hongkongensis* S.Y. Dong and a *T. harlandiii*-like specimen (PP = 1.0, MLBS = 94% and MPBL = 90%). In contrast, *T. crenata* and allied species were resolved in a different clade (IV-9, Fig. 3). Though *T. danangensis* was suggested as having a close affinity to *T. harlandii* (Hook.) C.M. Kuo, these two species are morphologically strikingly different in sori features. Specifically, *T. danangensis* has discrete sori, whereas *T. harlandii* has nearly acrostichoid sori. A comparison of morphological characters amongst *T. danangensis*, *T. poilanei* and *T. harlandii* is listed in Table 1.

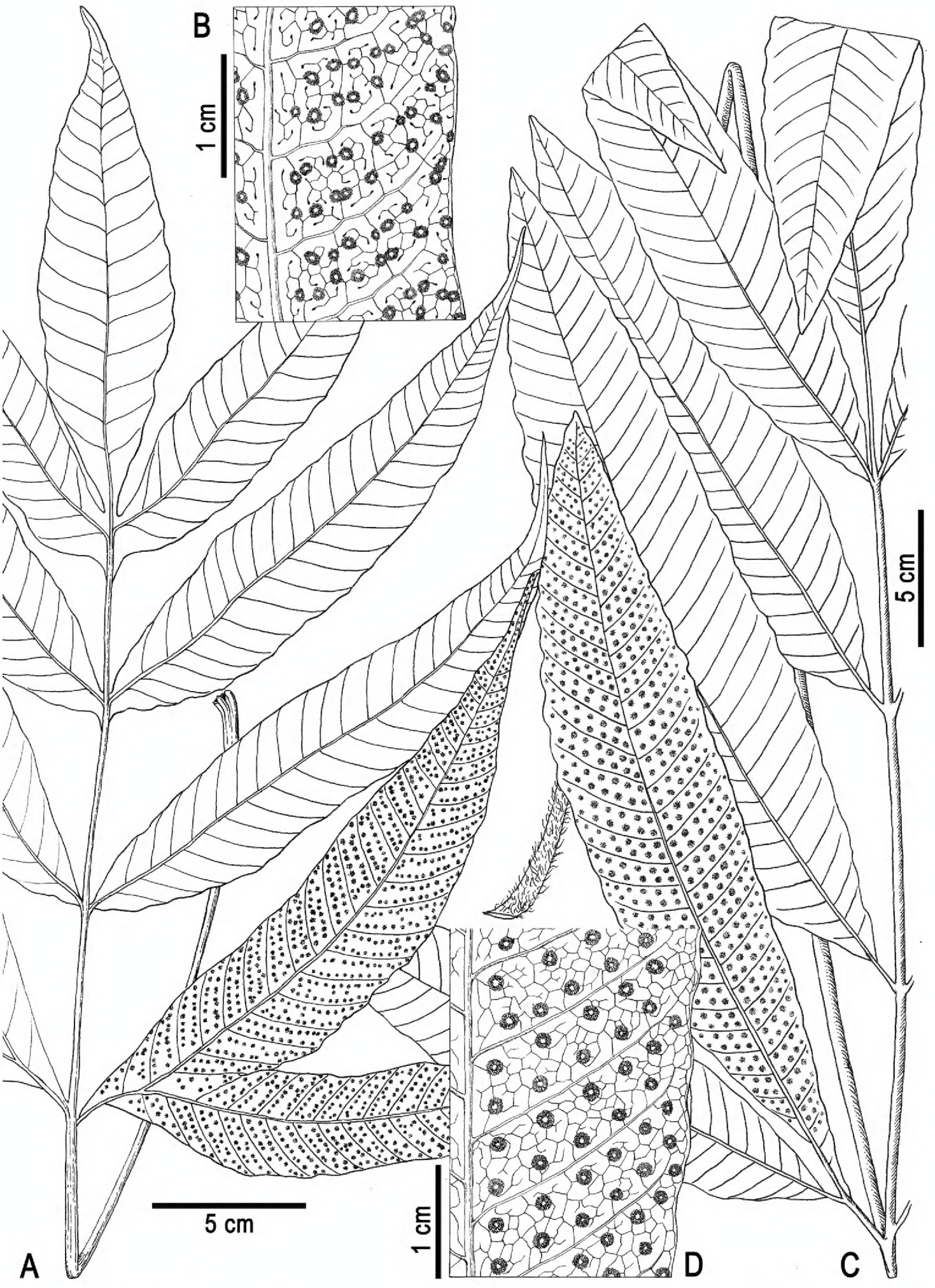

Figure 1. Morphological comparison between *Tectaria danangensis* (**A, B**) and *T. poilanei* (**C, D**) **A, C** habit **B, D** detail of a pinna showing venation and sori arrangement. Drawn by Shu-Han Li, with **A** and **B** based on *Dong 4909* (holotype, IBSC) and **C** and **D** on *Poilane 24074* (holotype, P).

Table 1. Morphological differences amongst *T. danangensis*, *T. fissa*, *T. harlandii* and *T. poilanei*.

	T. harlandii	***T. danangensis***	***T. poilanei***	***T. fissa***
Frond dimorphism	Strongly dimorphic	Mostly semi-dimorphic	Monomorphic	Monomorphic
Number of lateral pinnae/segments	1–3 pairs	2–5(6) pairs	3–4 pairs	1–5 pairs
Upper pinnae/segments	Adnate to rachis, mostly connate with terminal segment at base	Adnate to rachis, connate with terminal segment or not	Free, shortly petiolulate or sessile	Adnate to rachis, connate with terminal segment or not
Lobes on basal pinnae	Absent	Present; their bases connate to basal pinnae	Present; their bases cuneate, sessile or shortly petiolulate	Mostly present; their bases cuneate or connate
Wingless petioles of basal pinnae	Absent	Almost absent, 0–0.5 cm long	1.2–2 cm long	0–1.5 cm long
Transverse veins between lateral veins of pinnae	Distinct on sterile fronds, absent on fertile fronds	Variable, mostly indistinct	Absent	Distinct
Sori	Nearly acrostichoid, with sporangia running along veins between lateral veins	Round; irregularly in 2 rows between lateral veins, close or distant	Round; regularly in 2 rows between lateral veins, uniformly distant	Round; irregularly in 4–6 rows between lateral veins, close to each other
Indusia	Absent	Present	Present	Present

Discussion

Tardieu-Blot and Christensen (1941) overlooked the sori differences between *T. danangensis* and *T. crenata* and misidentified the former as the latter in Vietnam. Though having similar shape and dissection of fronds to *T. danangensis*, *T. crenata* and its allied species in Clade IV-9 (Fig. 3) (including *T. decurrens*, *T. pleiosora* (Alderw.) C. Chr. and *T. repanda* (Willd.) Holttum) differ from *T. danangensis* in their characteristic sori which are large and regularly 2-rowed between lateral veins, with each sorus being terminal on a single veinlet in an areole (Tagawa and Iwatsuki 1988: 372; Holttum 1991: 80). Such sori features are stable in these species and can be considered as a synapomorphy for Clade IV-9. In contrast, for species in Clade IV-8, the sori are never in regular two rows between lateral veins nor terminal on free veinlets included in areoles. Instead, their sori are relatively small, scattered between lateral veins and mostly borne on anastomosing veins in most species clustered in Clade IV-8, except for *T. danangensis*, *T. harlandii* and *T.* × *hongkongensis*. *Tectaria danangensis* has a unique arrangement of sori which are in irregular two rows between lateral veins (Fig. 1A and B); while in *T. harlandii* and *T.* × *hongkongensis*, the sori are nearly acrostichoid, with sporangia running along veinlets between lateral veins, as shown in Zhao and Dong (2016: Fig. 2C).

By examining specimens of all *Tectaria* species with 1-pinnate, pinnae-entire fronds recorded in Indochina and nearby regions (Tardieu-Blot and Christensen 1941; Tagawa and Iwatsuki 1988; Xing et al. 2013; Fraser-Jenkins et al. 2018), we found that some specimens of *T. danangensis* look very like those of *T. fissa* (Kunze) Holttum, a species frequently occurring in western Malesia but not in Indochina (Holttum 1991; Lindsay and Middleton 2012 onwards). A detailed comparison (Table 1) showed that

T. danangensis differs from *T. fissa* and other species having 1-pinnate fronds by its venation lacking distinct transverse veins between lateral veins and its sori being generally in only two rows (versus 4–6 rows) between lateral veins.

Tectaria danangensis appears to be an intermediate species between *T. harlandii* and *T. poilanei*; the latter (*T. poilanei*) has long been neglected in literature accounting for the fern flora of Indochina (e.g. Tardieu-Blot and Christensen 1941; Tagawa and Iwatsuki 1988; Phan 2010; Lindsay and Middleton 2012 onwards). According to herbarium specimens examined, *T. danangensis* is not rare in Vietnam; it has been collected from 1837 to 2014 across nearly all the country and, morphologically, is quite variable in the frond dimorphism and sori distribution between lateral veins. As shown in Table 1, some characters in *T. danangensis*, such as frond dimorphism, attachment pattern of pinnae to rachis, venation and sori distribution, exhibit intermediate states of those between *T. harlandii* and *T. poilanei*. Notably, *T. poilanei* is quite stable in pinnae features (i.e. the broad-lanceolate shape, lower pinnae consistently being petiolulate and basal pinnae each bearing a free basiscopic lobe), venation lacking transverse veins between lateral veins and regularly 2-rowed well-spaced sori (Fig. 1C and D); this species is currently represented, so far as we know, by its type specimen from southern Vietnam (Tardieu-Blot 1940) and a few collections from Thailand extend its distribution (e.g. *Beusekom & Smitinand 2193* (L) from Chantaburi, *Hansen & Smitinand 12644* (K, L) from Mae Hong Son and *Maxwell 04-156* (L) and *Hansen et al. 10886* (K, L) from Chiang Mai). Based on its variable morphology and frequently abortive sporangia, we hypothesised that *T. danangensis* possibly involved hybridisation with other species. Further studies, especially chromosome number and reproductive mode, are needed to better determine the origin of *T. danangensis* and its relationships with other *Tectaria* species.

Taxonomic treatment

***Tectaria danangensis* S.Y. Dong, sp. nov.**
urn:lsid:ipni.org:names:77296979-1
Figs 1A, B, 2

Type. Vietnam. On the border between Da Nang and Thua Thien Hue Prov.: Bach Ma National Park, 107°51'37"E, 16°17'59"N, 680 m elev., 02 Dec 2017, *S.Y. Dong 4909* (holotype: IBSC!, designated here; isotypes: HNU!, IBSC!).

Diagnosis. *Tectaria danangensis* is similar to *T. poilanei* Tardieu, but differs in its irregularly 2-rowed sori (versus regularly 2-rowed, well-spaced and evenly arranged) between lateral veins, fronds more or less being dimorphic (versus monomorphic) and basal pinnae each having a base-joined (versus free) lobe.

Description. Rhizome short, erect or decumbent. **Fronds** more or less dimorphic, with fertile fronds slightly contracted; stipe reddish-brown, 3–4 mm in diameter, 30–50 cm long, bearing scales only at base; scales lanceolate, ca. 8–10 × 1–1.5 mm,

Figure 2. Herbarium specimens of *Tectaria danangensis*, showing contracted fertile fronds (**A, C**) as compared with sterile fronds (**B, D**) **A, B** *Dong 4909* (type, IBSC) **C, D** *Cadiere 165* (P).

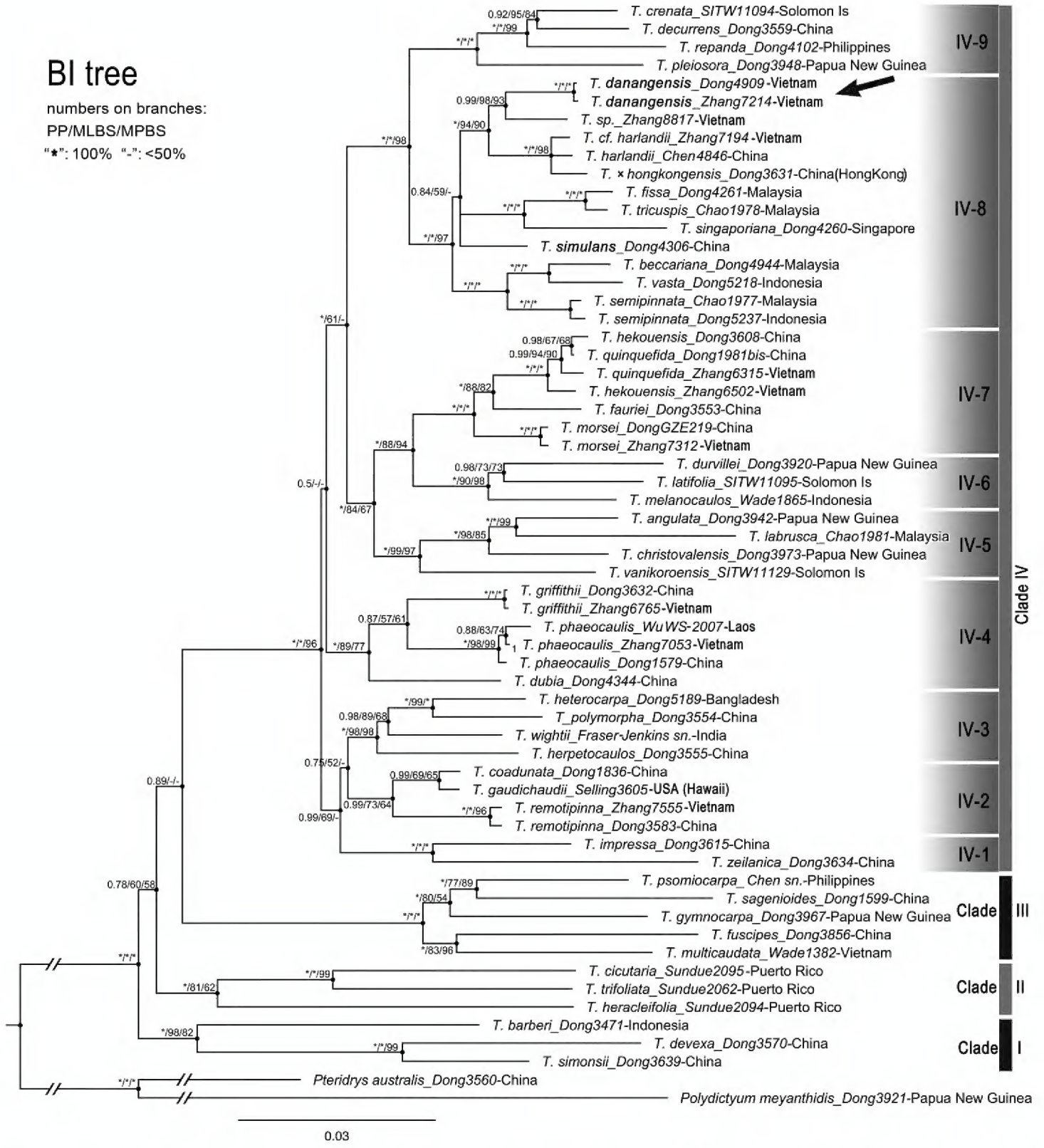

Figure 3. Bayesian consensus tree of *Tectaria*, based on combined plastid regions of *atpB*, *ndhF* + *ndhF-trnN*, *rbcL*, *rps16-matK* + *matK* and *trnL-F*. The position of the new species, *T. danangensis*, is indicated by an arrow.

reddish-brown; lamina nearly round or oblong, 35–55 × 25–35 cm, imparipinnate or terminated by tri-lobed segments, having 2–4(6) pairs of lateral pinnae, pinnae and segments entire at margin, herbaceous in texture, hairless; basal pinnae forked, 14–27(33) × 1.7–5 cm, petiolules 0–5 mm long, acroscopic base cuneate, basiscopic base round, apex caudate-acuminate, having a basiscopic lobe, the basiscopic lobes 7–24 × 1–3.5 cm; suprabasal pinnae linear, 14–30 × 1–4.5 cm, sessile, base cuneate, apex acuminate or caudate; upper pinnae similar to suprabasal pinnae in size and shape, but mostly adnate to rachis. **Veins** fully anastomosing, with most areoles having

included free or forked veinlets, transverse veins between lateral veins mostly indistinct. **Sori** round, borne on anastomosing veins, generally in two rows between lateral veins of pinnae (more or less with additional sori present beyond two rows), 8–11 each row in broad pinnae or 4–6 in obviously contracted fertile pinnae, well-spaced or adjacent. **Indusia** round-reniform, mostly curled and almost covered by sporangia when mature.

Distribution and habitat. Vietnam (Da Nang, Lam Dong, Quang Binh, Quang Nam, Quang Tri, Thanh Hoa, and Thua Thien Hue); terrestrial in broadleaved evergreen forest, occurring in slopes of valley or along mountain ridge, elev. 200–1400 m, locally common.

Additional specimens examined (paratypes). Vietnam. Da Nang: Ba Na Mountain, Hoa Vang District, *Sallet s.n.* (P); without locality, *Gaudichaud s.n.* (P). **Lam Dong**: Da Lat, *Wu et al. WP1447* (HN). **Quang Binh**: Phong Nha – Ke Bang National Park, *Nguyen NT39, NT69 & NT102* (HNU); without locality, *Phan s.n.* (HNU). **Quang Nam**: without locality, *Poilane 29484 & 31661* (P). **Quang Tri**: Huong Hoa District, *Averyanov et al. CPC2906 & CPC2907* (HNU); Dakrong District, *Phan et al. HLF6122* (HNU); Dakrong Nature Reserve, *Lu 19232* (TAIF); "Mai-lanh", *Poilane 1189* (P, PE, SING). **Thanh Hoa**: Phu luc, *Lecomte & Finet 1338* (P). **Thua Thien Hue**: A Luoi District, *Averyanov et al. HAL7289, HAL7342, HAL7423, HAL7622, HAL7738* (HNU); Nam Dong District, *Averyanov et al. HAL6940* (HNU); "Tua Luu", *Cadiere 165* (P). **Southern Vietnam** (Annam, with localities' names unreadable): *Eberhardt 373* (P).

Acknowledgements

We thank the curators of BM, BO, CDBI, E, HN, HNU, IBSC, K, KUN, L, P, PE, SING and TAIF for allowing access to their specimens, the Management Board and staff of Bach Ma National Park for specimens collecting permission and Nguyen Xuan Nghia and Le Tuan Anh for their help in fieldwork. Liang Zhang kindly provided photos of the collection *Zhang et al. 7214* which led to its identification as *Tectaria danangensis*. The work of V.T. Pham was supported by Van Lang University. This study was supported by National Natural Science Foundation of China (grant no. 31670203).

References

Copeland EB (1907) A revision of *Tectaria* with special regard to the Philippine species. Philippine Journal of Science 2: 409–418.

Ding HH, Chao YS, Callado JR, Dong SY (2014) Phylogeny and character evolution of the fern genus *Tectaria* (Tectariaceae) in the Old World inferred from chloroplast DNA sequences. Molecular Phylogenetics and Evolution 80: 66–78. https://doi.org/10.1016/j.ympev.2014.06.004

Dong SY, Chen CW, Tan SS, Zhao HG, Zuo ZY, Chao YS, Chang YH (2018) New insights on the phylogeny of *Tectaria* (Tectariaceae), with special reference to *Polydictyum* as a distinct lineage. Journal of Systematics and Evolution 56(2): 139–147. https://doi.org/10.1111/jse.12292

Dong SY, Chen CW, Tan SS, Huang L, Li SH (in press) An expanded plastid phylogeny of *Tectaria* (Tectariaceae), with description of four new species from the Solomon Islands. Systematic Botany.

Edler D, Klein J, Antonelli A, Silvestro D (2020) raxmlGUI 2.0: A graphical interface and toolkit for phylogenetic analyses using RAxML. Methods in Ecology and Evolution 12(2): 373–377. https://doi.org/10.1111/2041-210X.13512

Fraser-Jenkins CR, Gandhi KN, Kholia BS (2018) An annotated checklist of Indian pteridophytes, part-2. Bishen Singh Mahendra Pal Singh, Dehra Dun, 573 pp.

Hassler M (2004–2021) World Plants, synonymic checklist and distribution of ferns and lycophytes of the World. Version 12.8. http://worldplants.de

Holttum RE (1991) Flora Malesiana, series 2, Pteridophyta, vol. 2, part 1, *Tectaria* group. Rijksherbarium/Hortus Botanicus, Leiden, 132 pp.

Lindsay S, Middleton DJ (2012 onwards) Ferns of Thailand, Laos and Cambodia. http://rbgweb2.rbge.org.uk/thaiferns/

Phan KL (2010) The updated checklist of the fern flora of Vietnam following the classification scheme of A. Smith et al. (2006). Journal of Fairylake Botanical Garden 9(3): 1–13.

Posada D (2008) jModelTest: Phylogenetic model averaging. Molecular Biology and Evolution 25(7): 1253–1256. https://doi.org/10.1093/molbev/msn083

Ronquist F, Teslenko M, Van Der Mark P, Ayres DL, Darling A, Höhna S, Larget B, Liu L, Suchard MA, Huelsenbeck JP (2012) MrBayes 3.2: Efficient Bayesian phylogenetic inference and model choice across a large model space. Systematic Biology 61(3): 539–542. https://doi.org/10.1093/sysbio/sys029

Swofford DL (2002) PAUP: Phylogenetic analysis using parsimony (and other methods), version 4.0b10. Sinauer Associates, Sunderland.

Tagawa M, Iwatsuki K (1988) Dryopteridaceae. In: Smitinand T, Larsen K (Eds) Flora of Thailand 3(3). Royal Forest Department, Bangkok, 327–392.

Tardieu-Blot M (1940) Sur quelques fougères nouvelles ou récoltées pour la première fois en Indochine. Bulletin de la Société Botanique de France 87(2): 366–372. https://doi.org/10.1080/00378941.1940.10836440

Tardieu-Blot M, Christensen C (1941) *Tectaria*. Flore Générale de l'Indo-Chine 7(2): 402–423.

Xing FW, Yan YH, Christenhusz MJM (2013) *Tectaria*. In: Wu CY, Raven P, Hong DR (Eds) Flora of China, vols. 2–3. Missouri Botanical Garden Press, St. Louis; Science Press, Beijing, 733–746. http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=10291

Zhang L, Zhou XM, Chen DK, Schuettpelz E, Knapp R, Lu NT, Luong TT, Dang MT, Duan YF, He H, Gao XF, Zhang LB (2017) A global phylogeny of the fern genus *Tectaria* (Tectariaceae: Polypodiales) based on plastid and nuclear markers identifies major evolutionary lineages and suggests repeated evolution of free venation from anastomosing venation. Molecular Phylogenetics and Evolution 114: 295–333. https://doi.org/10.1016/j.ympev.2017.05.020

Zhao HG, Dong SY (2016) A new hybrid of *Tectaria* (Tectariaceae) from southern China. Phytotaxa 266(3): 213–218. https://doi.org/10.11646/phytotaxa.266.3.5

Appendix 1

Accessions used for phylogenetic analyses in this study. Information are arranged in this order: species name, voucher specimen (collector, number, and herbarium), place of origin, and GenBank numbers for *rbcL*, *atpB*, *rps16-matK* + *matK*, *ndhF* + *ndhF-trnN*, and *trnL-F* spacer (NA indicates data absent).

Polydictyum menyanthidis (C.Presl) Copel., *Dong 3921* (IBSC, LAE), Papua New Guinea (Lae), MF623752/MF623680/MF623704/MF623728/MF623776. ***Pteridrys australis*** Ching, *Dong 3560* (IBSC), China (Yunnan), KJ196892/KJ196486/KJ196796/KJ196678/KJ196522. ***Tectaria angulata*** (Willd.) Copel., *Dong 3942* (IBSC, LAE), Papua New Guinea (Kimbe), MF623756/MF623756/MF623708/MF623732/MF623779. ***Tectaria barberi*** (Hook.) Copel., *Dong 3471* (IBSC), Indonesia (Kalimantan), KJ196846/KJ196445/KJ196584/KJ196778/KJ196628. ***Tectaria beccariana*** (Ces.) C.Chr., *Dong 4944* (IBSC), Indonesia (Java), OK104174/OK480073/OK480115/OK480153/OK480194. ***Tectaria* cf. *harlandii*** (Hook.) C.M.Kuo, *Zhang et al. 7194* (CDBI), Vietnam (Ha Tinh), NA/NA/KY937237/NA/KY937513. ***Tectaria christovalensis*** (C.Chr.) Alston, *Dong 3973* (IBSC), Papua New Guinea (Kimbe), OK104179/OK480081/OK480121/OK480161/OK480202. ***Tectaria cicutaria*** (L.) Copel., *Sundue 2095* (VT), Puerto Rico, KJ196905/KJ196408/KJ196621/KJ196729/KJ196696. ***Tectaria coadunata*** (J.Sm.) C.Chr., *Dong 1836* (IBSC), China (Yunnan), KJ196878/KJ196451/KJ196531/KJ196779/KJ196661. ***Tectaria crenata*** Cav., *Chen et al. SITW11094* (BSIP, IBSC, TNM), Solomon Islands (Temotu), OK104204/OK480084/OK480124/OK480164/OK480205. ***Tectaria danangensis*** S.Y.Dong, *Dong4909* (HNU, IBSC), Vietnam (Da Nang), OM671282/OM671283/OM671284/OM671285/OM671286; *Zhang et al. 7214* (CDBI), Vietnam (Quang Binh), KY937368/NA/KY937261/NA/KY937550. ***Tectaria decurrens*** (C.Presl) Copel., *Dong 3559* (IBSC), China (Yunnan), KJ196870/KJ196471/KJ196535/KJ196741/KJ196674. ***Tectaria devexa*** (Kunze) Copel., *Dong 3570* (IBSC), China (Yunnan), KJ196883/KJ196456/KJ196787/KJ196668/KJ196605. ***Tectaria dubia*** (C.B.Clarke & Baker) Ching, *Dong 4344* (IBSC), China (Yunnan), MF623762/MF623690/MF623714/MF623738/MF623783. ***Tectaria durvillei*** (Bory) Holttum, *Dong 3920* (IBSC, LAE), Papua New Guinea (Lae), MF623763/MF623691/MF623715/MF623739/MF623784. ***Tectaria fauriei*** Tagawa, *Dong 3553* (IBSC), China (Yunnan), KJ196887/KJ196480/KJ196526/KJ196792/KJ196671. ***Tectaria fissa*** (Kunze) Holttum, *Dong 4261* (IBSC), Malaysia (Selangor), MF623766/MF623694/MF623718/MF623742/MF623787. ***Tectaria fuscipes*** (Bedd.) C.Chr., *Dong 3856* (IBSC), China (Hainan), MF623767/MF623695/MF623719/MF623743/MF623788. ***Tectaria gaudichaudii*** Maxon, *Selling 3605* (H), USA (Hawaii), KF887176/NA/NA/NA/NA. ***Tectaria griffithii*** (Baker) C.Chr., *Dong 3632* (IBSC), China (Guangxi), KJ196872/KJ196473/KJ196578/KJ196775/KJ196651; *Zhang et al. 6765* (CDBI), Vietnam (Bac Kan), KY937337/NA/KY937229/NA/KY937501. ***Tectaria gymnocarpa*** Copel., *Dong 3967* (IBSC), Papua New Guinea

(Kimbe), MF623765/MF623693/MF623717/MF623741/MF623786. ***Tectaria harlandii*** (Hook.) C.M.Kuo, *Chen et al. 4846* (IBSC), China (Guangdong), KJ196839/KJ196432/KJ196612/KJ196758/KJ196718. ***Tectaria hekouensis*** Ching & Chu H.Wang, *Dong 3608* (IBSC), China (Yunnan), KJ196894/KJ196487/KJ196520/KJ196799/NA; *Zhang et al. 6502* (CDBI), Vietnam (Hanoi), KY937340/NA/KY937238/NA/KY937514. ***Tectaria heracleifolia*** (Willd.) Underw., *Sundue 2094* (VT), Puerto Rico, KJ196904/KJ196407/KJ196597/KJ196728/KJ196695. ***Tectaria herpetocaulos*** Holttum, *Dong 3555* (IBSC), China (Yunnan), KJ196884/KJ196482/KJ196570/KJ196789/KJ196669. ***Tectaria heterocarpa*** (Bedd.) C.V.Morton, *Dong 5189* (IBSC), Bangladesh (Sylhet), MW795598/MW795606/MW795612/MW795620/MW795628. ***Tectaria*** × ***hongkongensis*** S.Y.Dong, *Dong 3631* (IBSC), China (Hong Kong), KJ196886/KJ196484/KJ196568/KJ196783/KJ196666. ***Tectaria impressa*** (Fée) Holttum, *Dong 3615* (IBSC), China (Yunnan), KJ196841/KJ196420/KJ196536/KJ196772/KJ196626. ***Tectaria labrusca*** (Hook.) Copel., *Chao 1981* (TAIF), Malaysia (Sarawak), KJ196818/KJ196499/KJ196600/KJ196745/KJ196692. ***Tectaria latifolia*** (G.Forst.) Copel., *Chen et al. SITW11095* (BSIP, IBSC, TAIF, TNM), Solomon Islands (Temotu), OK104190/OK480096/OK480135/OK480174/OK480217. ***Tectaria melanocaulos*** (Blume) Copel., *Chen Wade1865* (TAIF), Indonesia (Java), KJ196832/KJ196422/KJ196562/KJ196735/KJ196709. ***Tectaria morsei*** (Baker) S.Y.Dong, *Dong GZE219* (IBSC), China (Guizhou), KJ196893/KJ196418/KJ196521/KJ196798/KF561675; *Zhang et al. 7312* (CDBI), Vietnam (Quang Binh), KU605205/NA/KU605139/NA/KU605117. ***Tectaria multicaudata*** (C.B.Clarke) Ching, *Chen Wade1382* (TAIF), Vietnam (Bu Gia Map National Park), KJ196834/KJ196425/KJ196558/KJ196756/KJ196713. ***Tectaria phaeocaulis*** (Rosenst.) C.Chr., *Dong 1579* (IBSC), China (Hainan), KJ196879/KJ196453/KJ196546/KJ196780/KJ196662; *Zhang et al. 7053* (CDBI), Vietnam (Thanh Hoa), KU605201/NA/KU605142/NA/KU605119; *Wu WS-2007* (KUN, MO), Laos, NA/NA/NA/NA/KY937532. ***Tectaria pleiosora*** (Alderw.) C.Chr., *Dong 3948* (IBSC, LAE), Papua New Guinea (Kimbe), MF623759/MF623687/MF623711/MF623735/MF623793. ***Tectaria polymorpha*** (Hook.) Copel., *Dong 3554* (IBSC), China (Yunnan), J196889/KJ196477/KJ196524/KJ196794/KJ196657. ***Tectaria psomiocarpa*** S.Y.Dong, *Chen s.n.* (TAIF), Philippines (Luzon), J196822/KJ196502/KJ196595/KJ196723/KJ196698. ***Tectaria quinquefida*** (Baker) Ching, *Dong 1981bis* (IBSC), China (Yunnan), KJ196885/KJ196483/KJ196528/KJ196890/KJ396622; *Zhang et al. 6315* (CDBI), Vietnam (Hoa Binh), KY937358/NA/KY937250/NA/KY937537. ***Tectaria remotipinna*** Ching & Chu H.Wang, *Dong 3583* (IBSC), China (Yunnan), KJ196851/KJ196450/KJ196574/KJ196781/KJ196663; *Zhang et al. 7555* (CDBI), Vietnam (Quang Tri), KY937325/NA/NA/NA/KY937482. ***Tectaria repanda*** (Willd.) Holttum, *Dong 4102* (IBSC), Philippines (Palawan), OK104195/OK480104/OK480144/OK480183/OK480228. ***Tectaria sagenioides*** (Mett.) Christenh., *Dong 1599* (IBSC), China (Hainan), KJ196896/KJ196436/KJ196550/KJ196760/KJ196625. ***Tectaria semipinnata*** (Roxb.) C.V.Morton, *Chao 1977* (TAIF), Malaysia, KJ196817/KJ196498/KJ196601/KJ196744/KJ196691; *Dong 5237* (IBSC),

Indonesia (Sumatra), NA/OK480106/OK480146/OK480185/OK480230. ***Tectaria simonsii*** (Baker) Ching, *Dong 3639* (IBSC), China (Guangxi), KJ196837/KJ196430/KJ196555/KJ196730/KJ196717. ***Tectaria simulans*** Ching, *Dong 4306* (IBSC), China (Yunnan), OK104197/OK480108/OK480148/OK480187/OK480231. ***Tectaria singaporiana*** (Hook. & Grev.) Copel., *Dong 4260* (IBSC), Singapore, MF623771/MF623699/MF623723/MF623747/MF623791. ***Tectaria* sp.**, *Zhang et al. 8817* (CDBI), Vietnam (Khanh Hoa), NA/NA/KY937269/NA/KY937557. ***Tectaria tricuspis*** (Bedd.) Copel., *Chao 1978* (TAIF), Malaysia (Kuala Lumpur), KJ196820/KJ196501/KJ196598/KJ196847/KJ196694. ***Tectaria trifoliata*** (L.) Cav., *Sundue 2062* (VT), Puerto Rico, KJ196901/KJ196409/KJ196565/KJ196848/NA. ***Tectaria vanikoroensis*** S.Y.Dong & C.W.Chen (ined.), *Chen et al. SITW11129* (BSIP, IBSC, TNM), Solomon Islands (Temotu), OK104200/OK480111/NA/OK480190/OK480234. ***Tectaria vasta*** (Blume) Copel., *Dong 5218* (IBSC), Indonesia (Sumatra), NA/OK480112/OK480151/OK480191/NA. ***Tectaria wightii*** (C.B.Clarke) Ching, *Fraser-Jenkins s.n.* (TAIF), India (Kerala), KJ196906/KJ196416/KJ196561/KJ196732/KJ196710. ***Tectaria zeilanica*** (Houtt.) Sledge, *Dong 3634* (IBSC), China (Yunnan), KJ196862/KJ196442/KJ196540/KJ196768/KJ196637.